Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

APPLIED NUTRITION FOR RAISING THE STANDARD OF CHILD VITALITY

By Professor I. NEWTON KUGELMASS

HEAD OF THE DEPARTMENT OF CHEMISTRY, HOWARD COLLEGE

WHILE approaching the brink of the dawn of a world cataclysm that catalyzed evolutionary progress in both humane and inhumane activities, let us take inventory of a phase fundamental in world domism—the "reconstruction" problem of child welfare.

The war has sobered us and its lessons must be taken truly to heart for our sufferings were our instructors, Pathemata Mathemata. Of the doctrines reaped, two point for our consideration—(1) the necessity for physical and mental efficiency in every citizen and (2) the menace of the dearth of youth.

Ours is the great obligation to build the rising generation an optimum in body, mind and character if we are to carry into the future the strength and steadfastness which mark the present. Sentiment and emotion alone eventually fade into oblivion —the deadly policy of laisser faire, laisser passer. They must be translated into practical terms of concentrated effort and endeavor; now is the time. Let nothing mar nor hinder, not even the blood-coagulating dollar. The time is here, the place is everywhere and the obligation every one's to serve in the cause of national upbuilding through child welfare, for the child is the embryo of the nation's progress, the parent of the future generation, the potential citizen.

THE ANTECEDENT FACTORS OF THE RESULTING CHILD

The caliber of the child may be expressed as the resultant of the two "moments," heredity, the intrinsic organization of the germ cells and environment, the extrinsic, stimulating, inhibiting or modifying influences. Evidently to attain the ideal child

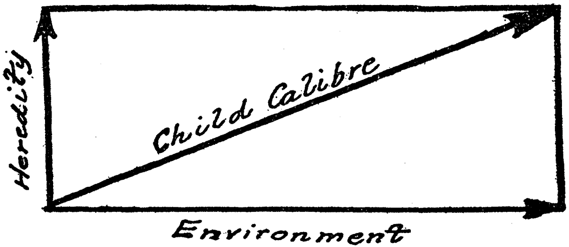

FIG. 1.

these two causative factors must be ideal. Modern applied scientific tendencies have been in the direction of "patching-up" the child rather than in the more important or at least as important fields of heredity and environment perfection. There is nothing against these tendencies except that they are unbalanced. To raise the health standard of the average child we need science in the service of alleviating the ill-causes much more so than remedying the ill-effects.

Let us throw the balance in the other—the more serviceable direction. Curing superficial symptoms of woeful causative inadequacies has never and will never relieve the situation. We need to face and cure both evils equally to serve as we should and as we can with intelligent application of our available knowledge. The application of the sciences on child welfare have thus far been delinquent and the more that "one-sidedness" is practised the longer the prolongation of our low heredity status to our own detriment and that of the coming generations upon which the nation's future depends. Of the two causative factors in child molding—heredity and environment—the latter promises far more effective returns per unit effort, but both are in dire need of attention.

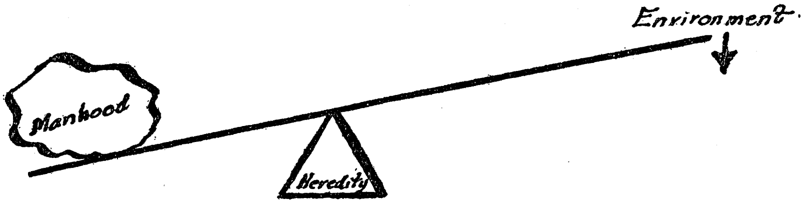

FIG. 2.

For our immediate purpose let us consider environment and its component influences of which the home and the school are the most permeating. The salvation of the child lies in the complete harmony of school and home functioning with the body developments of the child with age.

CHILDHOOD IN CONSTANT FLUX AND REFLUX

An analysis of body developments with age shows the child not a miniature man, but distinctly different from the adult in vitality, intellect, emotion, instinct and metabolism. As a matter of fact, these intrinsic differences are characterized throughout childhood by their constant alternation in activity and passivity. Child metamorphosis proceeds with constant flux and reflux—a living illustration of Newton's Third Law of Motion: "Action $\rightleftharpoons$ Reaction."

Periodicity of Action and Reaction in Human Metamorphosis

Age	Growth	Coordination	Development	Characteristics			
Birth to 7	Rapid	Motor	Corporeal	Endothermic	Receptivity	Stimulation	Exaltation
7–14	Slow	Motion and emotion	Intellectual	Exothermic	Productivity	Fatigue	Depression
14–17	Sudden		Corporeal	Endothermic	Receptivity	Stimulation	Exaltation
18–25	Slow	Emotions and ideals	Intellectual	Exothermic	Productivity	Fatigue	Depression

The Relations of School Life to the Critical Transition Epochs in Child Development

In the light of the above analysis of human metamorphosis the school's responsibility in molding childhood in harmony with its fluxating development is evident. Thanks to the world educators and psychologists for stimulating research in the cause, but as yet our school systems are far from what they should and could be.

The effects of school life upon the child are appalling. Extensive surveys throughout the country have shown persistent prevalence among school children of: (1) growth retardation, (2) appetite deterioration, (3) corpuscle degeneration, (4) blood deoxygenation, (5) metabolic alterations, (6) superficial respiration, (7) morbidity, (8) malnutrition, (9) remediable defects, (10) reduced vitality. Is the school functioning harmoniously with the development periods of the child? Is the home guilty of negligent depreciation of vitality through inadequate nurture, health conditions and care? Yes, the school and the home are the reciprocally responsible sources.

The scope of the educational machinery is still narrow if its aims are not generally all-inclusive and well-balanced, if its habitual training for healthy physique is not on par with the mental. The great problem at our advanced stage is to get away from an education for a living to an education for a life to best enable and set free each individual to do his and her best for the common welfare. Upon that necessary and sufficient transition in educational ideals pends the safeguarding, upbuilding and perpetuating of our American democracy.

Then too the "rule-of-thumb" empiricism for bringing up children is incompatible with their variant needs. Deficiencies heaping up thereby as a result of neglect and ignorance among poor and rich alike rob humanity of latent productivity—a great impediment upon our nation, an irretrievable waste of our rising generation. The scientific and rational principles of health and nutrition must become more assimilated into the conceptions and practises of the public or even the medical profession if we are to build a maximum efficient democracy.

Applied Nutrition for Raising the Standard of Child Vitality

With the vast number of variegated food materials, natural and artificial, palatable and adulterated, drugged and normal all behind attractive camouflaged labels it behooves one to select what will constitute an adequate diet for the growing child. Faulty diets have been devitalizing the innocent child with resultant deficiency diseases. Malnutrition has impoverished the child world with reduced vitality, disease susceptibility, minimized educational receptivity, anæmified physique and resultant stunting of mental and physical development—basic elements for mollycoddles not men, wishbones not backbones, jellyfish not brains. The retribution for dietetic sins in childhood is a much more speedy reaction than in adult age. Stop the starving, stunting, stultifying of the child. It's criminal. Every child has a biologic birthright to a useful body and mind. Grant that right by complying with natural laws governing body needs formulated by science. The science of nutrition is at our service.

Instinct a Non-reliable Guide in Food-selection.—The perpetuity of change in the human species modifies simultaneously the dependent factors on health preservation as a result of the curtailment of the activities of various parts of the body so that claiming practicability of instinct as a natural guide on the basis of past service to humanity is irrelevant. Furthermore, instinct varies with personal idiosyncrasy, habits, conventions, moods—conditions not necessarily compatible with food value to the body. Reliable knowledge should be if it is not at the command of all to supplant inherited instincts.

From Birth

(Relative in proportion to body weight)

Increase	*Decrease*
1. Density of blood.	1. Water in blood.
2. Concentrated red corpuscles.	2. Concentrated white corpuscles.
3. Concentrated haemoglobin.	3. Iron content.
4. Mineral matter.	4. Organic Matter.
5. Calcium carbonate.	5. Calcium phosphate.
6. Oxygen absorption.	6. Thyroid gland, kidneys, thymus.
7. CO_2 excretion.	7. Suprarenal capsules.
8. Colloidal substances.	
9. Brain, heart, lungs.	
10. Metabolic intensity.	

The Child Needs (1) tissue foods, (2) energy foods, (3) regulating foods, (4) protective foods. Nutritional instruction should be on the basis of food function rather than composition of interest to the chemist only since the former appeals to the pupil's actual experience and familiarity while the latter rarely strikes "home."

The general factors interrelated with child nutrition are a knowledge of (1) food functions in body, (2) essential body component sources in foods, (3) relative amounts of food required per age, (4) adaptable foods to the digestive system, rate of growth, state of development, (5) feeding intervals per age, (6) proper sequence at mealtime.

THE TISSUE FOODS

Feeding children involves not only waste repair, the adult need, but new tissue building as well if the child's growth is not to be stunted. The body tissues are: (1) The circulating—blood, (2) the master—brain and nervous system, (3) the contractile—muscles, (4) the supporting—bones and teeth, (5) the cryptorrhetic—thyroid and secretions.

A diet may contain all the necessary constituents for tissue repair and yet may be lacking in some constituents essential for new tissue growth. If these constituents can not be formed in the child organisms as they can in the adult out of others in the diet, it is evident that they must be supplied to the child from without else abide by the fate of inadequate dieting. The animal and vegetable complex proteins upon the action of proteolytic enzymes in the stomach are ultimately hydrolyzed into the digestion products essentially the various amino-acids. These, absorbed into the blood, are the building units of the body tissues to be formed. Since different protein foods contain not all of the amino-acids essential for tissue synthesis and in different proportions, it is very essential that the child get a proper combination of proteins for the body availability of all the amino-acids and their right proportions required for both new tissue building as well as for tissue repair. It is not strictly protein as such, but amino-acids that the body needs. Those indispensable to growth are arginin, cystin, histidin, lisin, and those essential to maintenance or tissue repair are the aromatic amino-acids. Any surplus is partly converted by de-amination into carbohydrate and fat to contribute to the body's energy requirements. In all the child's total protein requirement is more per unit body weight than the adult's. This does not mean, as is the usual misapprehension, that the proportion of proteins to total food intake is greater. The normal need is protein to be ten per cent. of the total ration for children as well as for adults. The necessary and sufficient protein utilization and assimilation depend on what may be termed the *amino-acid efficiency* of the ingested food. From this standpoint a few foods may be graded as follows: (1) milk, eggs, cheese, meat, fish; (2) wheat, oats, pulses, nuts; (3) corn; (4) gelatin. This does not mean that only those in (1) should be consumed, for the others may have essential components for other body functions. It does point, however, to the necessity for guarding children's diet so that upon digestion the specific kinds and proportions of amino-acids will be available.

In infant feeding the available chemical components of foods are not the only factors, but their physiologic functions must be considered as well. During the nursing period the infant is not adapted for the metabolism of nutrients derived from sources other than woman's milk. Breast feeding develops the digestive tract, functions in better brain and nerve building by the lecithin content in the milk, gives all the amino-acids in the proportions requisite for growth, serves for stronger teeth and is generally correlated with higher mortality. Furthermore, *B. bifidus* is present to the exclusion of other forms in the normal breast-fed child. It produces no putrefaction, decomposes no albuminous matter which would form toxic products. These bacilli are more than harmless, they are an important defense in preventing intestinal putrefaction and displacing harmful flora.

THE ENERGY FOODS

Children's energy requirement is greater per unit surface area of the body than the adult's because of their higher metabolism. *The energy functions* for keeping body temperature normal, for the maintenance of the life processes more rapid than in adult, for muscular activity, for body syntheses of the building materials utilized in repair and growth, and for storage.

The carbohydrates are absorbed into the blood plasma as monosaccharides after intestinal digestion. These upon oxidation liberate energy for the performance of muscular movements as well as for bringing about endothermal reactions. Any surplus is stored in the liver, muscles and other organs as glycogen. Excessive amounts beyond the normal assimilation limit of the organs tend to be transformed into fat.

Fat, the concentrated potential energy source, after being hydrolyzed in the stomach yields fatty acids and glycerol which are absorbed by the lymph vessels and together taken up by the blood plasma, distributed to the tissues according to their needs, contributing to the constitution of protoplasm as well as for heat production. Any excess aids the conservation of body heat.

Any excess protein intake will be de-aminized, yielding carbohydrates and probably fats for the body's energy requirements. In other words all foods are sources for heat and muscular movements in proportion to body preference, specific nutrient availability and surplus.

In child development the specificity of carbohydrate function is prevalent. Galactose, for instance, is essential for nerve medullation of the cerebrum. It is derived from lactose, the milk sugar and none other will replace it. Again, milk, although containing an insufficiency of the total carbohydrate requirement, has the essential sugars entering into the composition of the child's body. Another favorable point is that lactose in milk is least liable to fermentation, whereas all other sugars yield acid products in the stomach.

Sugar is a beneficial muscle food for the children if taken in diluted form. Excessively large concentrated amounts of sugar ingested irritate the tissue, abnormally increase the mucous secretion as well as the acid gastric juice content, thereby interfering with normal digestion. Furthermore, the requisite vegetable food intake will be diminished since it satisfies the appetite without adequate nourishment with serious consequences of the deficiency diet to growing children.

The four per cent. fat content in milk in the emulsified palatable and easily digested form is the optimum satisfying the caloric need of the normal child. Excessive fat ingestion overtaxes the infant's undeveloped digestive system, causing the prevalent gastrointestinal indigestion with a simultaneous loss of alkalinity which may result in acidosis.

THE REGULATING FOODS.

During the functional activity of the child mineral nutrients are indispensable for all tissue building providing the supporting structures as well as for metabolic regulation. Among the diverse functions of the inorganic components in the body are:

A. As Stimulators—
  a. Conducting nerve impulses.
  b. Activating enzymic transformations.
  c. Increasing metabolic reaction velocity.
  d. Catalyzing cellular activity.

B. As Regulators—
  - *a.* Controlling heart and muscular activity.
  - *b.* Maintaining blood acid-base equilibrium.
  - *c.* Counteracting harmful products by chemical combination.
  - *d.* Governing respiration processes.
  - *e.* Aiding proper membrane permeability.
  - *f.* Providing a solution concentration of normal osmotic pressure.

The prevalence of anemia during the weaning period of the infant is due to iron inadequacy, which causes a diminution in the hemoglobin and chromatin bodies, both largely responsible for metabolic and growth processes. It is imperative that special provision be made in the child's diet for an iron content sufficient for both body maintenance and increasing blood supply, since the iron reserve continually diminishes from birth on. The iron component in the daily ration should not be the sport of chance, but purposeful inclusion if due justice is to be afforded to the child's development. Medicinal inorganic iron in tonics is not only a costly substitute for a healthy dietary violation, but no actual substitute at all since it is temporary acting as a stimulus rather than a hemoglobin producer. You can not beat nature to it, but accept her organic iron in foods combined in assimilable form for the body.

Malnutrition associated with flabbiness, weak bones and teeth are a direct result of phosphorus deficiency. Retarded development, structural weakness and rickets observed in children are effects of calcium inadequacy. The structural supporting tissues partake of the continuous metabolic changes as well as the others. The former need continual replenishment as well as the latter. The child's need in addition to the normal calcium and phosphorus assimilation in all tissues is a sufficiency for the constant structural increase during growth.

Children must have an adequate supply of inorganic components. As a matter of fact maximum duration of life depends on the maintenance of a concentration of salts in the blood proportional to those found in the sea, an experimental fact (Loeb) probably correlated with the marine origin of vertebrates.

Life depreciation is evident if we view the ill-effects of mineral deficiency. Just protein-carbohydrate-fat diet is disastrous. It means an acid laden system without any alkalies from mineral sources for neutralization. Intestinal putrefaction is immensely increased, a condition largely responsible for fifty per cent. of body impairment. Furthermore, interference with the body-regulating and stimulating powers will inevitably result in nervous and muscular disturbances—constipation, acidosis, scurvy and what not. The familiar grouch is a living example of mineral deficiency in the diet. Keep the child blooming with a positive and ever-pleasant disposition by sufficient mineral salt provision.

In the table below the foods are arranged in the order of diminishing content of the essential mineral constituents per unit weight of fresh food compiled from Professor Sherman's tabulations in his "Chemistry of Food and Nutrition." Iron, phosphorus and calcium are listed because of the liability of inadequate provision in the child's daily ration.

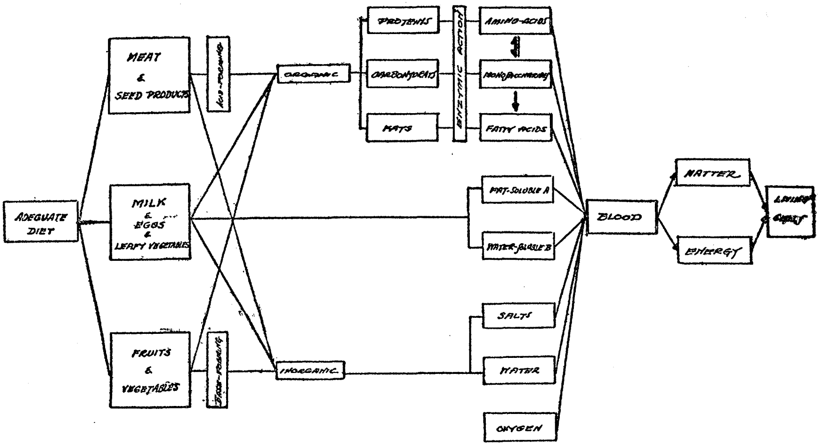

FIG. 3. THE METABOLIC COURSE OF FOODS.

Iron

Beans (lima, dried)
Beans (navy, dried)
Peas (dried)
Wheat (entire grain)
Beafsteak (lean)
Spinach
Oatmeal
Raisins
Eggs
Prunes (dried)
Beans (string)
Corn meal
Potatoes
Barley flour
Cabbage
Corn (sweet)
Rice (polished)
Apples
Milk

Phosphorus

Beans (navy, dried)
Egg yolk
Peas (dried)
Peanuts
Wheat (entire grain)
Oatmeal
Almonds
Walnuts
Beef (lean)
Rice (polished)
Parsnips
Potatoes
Turnips
Beets
Pineapples
Bananas
Oranges
Apples

Calcium

Almonds
Beans (dried)
Egg yolk
Milk
Peas (dried)
Oatmeal
Walnuts
Peanuts
Turnips
Parsnips
Carrots
Oranges
Prunes (dried)
Wheat (entire grain)
Beets
Beans (dried)

WATER AS A REGULATING FOOD

The internal body medium which makes vital processes possible is water. It is the most abundant cell and blood component. Common as it is water is endowed with the most wonderful properties, nature's special provision for its following regulatory functions: (1) maintains normal body temperature, (2) solvent and dispersion medium, (3) accelerates chemical reactions, (4) transfers heat between cells, (5) conveys food and oxygen to the tissues, (6) removes metabolic waste products, (7) coordinates metabolic processes.

The water content of the body is not a function of body weight, but of age. The infant needs four times as much water as the adult per body weight. This indicates that we are gradually "drying out" with seventy per cent. water content in youth diminishing to fifty-eight per cent. in adult age, but for the sake of growth beware "drying" the child, for tissue efficiency varies directly as the water content therein. Furthermore, the body carbohydrates and fats form stable dispersion systems with water—essential criteria for soundness of constitution. Any water deficiency for the child may result in (1) growth disturbances, (2) muscular slackness, (3) gastro-intestinal indigestion, (4) discordant metabolic coordination, (5) fluctuating fever, (6) increasing blood viscosity, (7) increased catabolism. Let the child have plenty of water during and between meals. A glass of water on rising and one on retiring will supplant many a purgative dose.

THE PROTECTIVE FOODS

Biologic studies correlated with chemical have led McCollum and his co-workers to the recently extolled conclusions of profound importance in child nutrition that life perishes without foods containing fat-soluble A and water-soluble B. Faulty diets have been largely responsible for "deficiency diseases," *e. g.*, xerophthalmia, beri-beri, scurvy, pellagra and rickets. Adding these two unidentified substances brings about recovery. Insuring a non-appearance of any of these diseases, or rather making the child immune to them, lies in the ingestion of foods containing these two essential components. They stimulate growth and well-being probably by initiating and coordinating the protoplasmic formation reactions among the essential components prepared by the digestive processes. The more of them the child gets the better it feels.

The protective foods containing them are milk and the leafy vegetables. Here too their relative functioning is of marked gradation. As a matter of fact a nation's status may be interpreted from the standpoint of its utilizing milk or leafy vegetables or both as its protective foods. As McCollum puts it:

> Those peoples who have employed the leaf of the plant as their sole protective food are characterized by small stature, relative short span of life, high infant mortality, and by contented adherence to the employment of the simple mechanical inventions of their forefathers. The peoples who have made liberal use of milk as a food, have, in contrast, attained greater size, greater longevity, and have been much more successful in the rearing of their young. They have been more aggressive than the non-milk-using peoples, and have achieved much greater advancement in literature, science and art. They have developed in a higher degree educational and political systems which offer the greatest opportunity for the individual to develop his powers. Such development has a physiological basis and there seems every reason to believe that it is fundamentally related to nutrition.

Just as the sulphuric-acid output is the chemical barometer of a nation, so the amount of milk production is its health barometer. Milk has no duplicate, no substitute. It towers above all other foods. It is nature's best agent for child-building and a national wide provision must be made for its ready access to the growing child if our goal is human personality well grown and ready in body and mind.

THE CHILD'S ADEQUATE DIET

Satisfactory nutrition for optimum child growth and development is attained by diets well-proportioned in the essential foodstuffs with plenty of water.

⅓	⅓	⅓
Milk.	Meat, Eggs, Seed Products.	Fruits, Vegetables and the Leafy Vegetables.

An additional dietary factor of vital importance, a daily American mispractice is the lack of balance of acid and base forming foods. If the nutrients are present in proportion to the body's requirement the bases will predominate. The foods below are listed in the order of their decreasing resultant acidity or basicity as demonstrated by Professor Sherman of Columbia University.

Acid-Forming

Egg yolk
Fish (haddock)
Meat (lean beef)
Oatmeal
Eggs
Wheat (entire)
Rice
Crackers
Egg-white

Cereals, meat and fish
Acid Elements: Cl, S. P.

Base-Forming

Beans (lima, dried)
Beans (dried)
Raisins
Celery
Cantaloup
Lettuce
Potatoes
Oranges
Lemons
Bananas
Cauliflower
Cabbage
Apples
Milk (cow's)

Fruit and vegetables
Basic Elements: Na, K, Ca, Mg

The child's normal diet should consist of sufficient milk, fruits and vegetables to neutralize the acids formed from the other foods. The American custom of acid-forming dessert is largely the cause of her dental troubles at the child's early age. These sweet or starchy foods decompose in the interstices of the teeth with the production of acids which diminish the saliva alkalinity, flow and effectiveness. The acids further act upon the lime salts of the enamel, favor tartar deposition and pus formation in the alveoli, thus giving entrance to microorganisms which destroy the tooth structure. The French dessert principle is correct. It is a base-forming food—fruit. It is wrong for parental customs, conventions and idiosyncrasies to victimize the innocent child.

The quantitative feature as well as the qualitative is of important concern in dietary rationing. Waste of the rising generation is too evident for malnutrition through under nourishment not to be considered. It is well to abide by the child's total food requirement with greater per unit weight and also per unit surface than the adult's. In fulfillment of this requirement it is not necessary to use analytical scales or resort to extensive calculation of a man in full vigor at moderate work; the following fractional parts per age may be used to advantage.

Man	1.0
Woman	0.8
Boys (14–17)	0.8
Girls (14–17)	0.7
Children (10–13)	0.6
Children (6–9)	0.5
Children (2–5)	0.4
Under 2	0.3

RELATIVE TOTAL FOOD REQUIREMENT.

To recapitulate, the child's diet is different from the adult's in some of the following respects: (1) Natural and simple, (2) plenty of milk and leafy vegetables, (3) plenty of water, (4) no stimulants, (5) no highly seasoned foods, (6) hard foods during tooth development, (7) coarse, fibrous foods for smoothening teeth surfaces, (8) heartiest meal at noon, (9) no food between meals, (10) no sweets at the beginning or end of meal.

From the above considerations we realize that body needs are governed by natural laws formulated by science. The closer the adherence and the more intelligent the application of the available knowledge the higher the standard of public health and vitality. Educational reforms will bring the science of nutrition from the theoretical background to the practical front. For that indispensable service we need universal instruction in nutrition, dietetics, prophylaxis, child health; competent trained elementary school teachers and health visitors in nutrition and public health; infant welfare centers; social service staffs; more social-unit organization work under the auspices of the child-welfare leagues and child health associations; public cooperative kitchens; public demonstration centers; public-school child feeding; regular and periodic inspection of school children; more financial aid to mothers; more housekeepers' clubs; more public lectures on health, nutrition and sanitation. The public can not go to the schools; we must go to the public.